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TRAINING, PRACTICE AND MENTAL LONGEVITY¹

By Professor WALTER R. MILES

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"EVERY body knows," wrote Cohausen in 1742, "how grateful and refreshing we discern the breath of cows to be, which is thence supposed, exceedingly wholesome; . . . There seems, therefore, to be nothing forced or absurd, in conceiving that the warm, active, and balsamic particles thrown off by the lungs of young people into the air, which they respire, may give it such a quality, as when sucked in again by a person in years, shall communicate an extraordinary force to the circulating humors in his body, and so quicken and enliven them, as to bestow a kind of reflective youthfulness, which may for many years keep off and delay those infirmities, to which people of the same age are generally subject. The more we consider this doctrine . . . the more we shall be satisfied of the truth of this conjecture, and the more

¹ Address of the retiring vice-president and chairman of the section on psychology, American Association for the Advancement of Science, Pittsburgh, December 28, 1934.

credible this invention of Hermippus will appear."² The indulgent smiles called forth by this hot-air paragraph of hope from a former generation give pause to anyone who undertakes a discourse on any phase of the subject of longevity. The perennial search for the *elixir vitae* stands as one of the seven extravagancies of the mind of man, and he who openly shows himself to be a prospector here or near here may expect to hear voices in concert quoting, "What fools these mortals be!"

Having answered to the description and having attended to these introductory formalities of the occasion may I then proceed to tell you what I intend to say. This paper will deal with normal longevity from a psychological viewpoint. It will not concern cen-

² J. H. Cohausen, "Hermippus Redivivus: Or the Sage's Triumph Over Old Age and the Grave." Tr. into English by J. Campbell. Edited by E. Goldsmid. In three volumes. Privately printed, Edinburgh, 1885, Vol. 1, pp. 20 and 27.

tenarians, nonagenarians, or even octogenarians. There will be no attempted consideration of the factors of race, heredity, climate, food, drink, rural *versus* urban surroundings, marital state, or medical care. These stock topics concerning a man's family, place and physical way of living constitute the subject-matter for the often trite inquirer, which, throughout countless generations, have been made about nearly every human who has happened to be an example of extended or abnormal longevity. I shall try rather to interrogate the ways of the mind than those of the body, inseparable though mind and body appear to be. The type and regimen of inner experience that perchance is positively correlated with preferred mental-life risk or prospect is what I desire to glimpse. The ancient query, "Can a man by taking thought add one cubit to his stature?" implied a prompt unreserved "no" as answer. But the familiar phrase, training accentuates psychological traits and practise makes perfect, we readily accept as applicable to the baby, the child and the adolescent. The young or moderately young by taking thought, we believe, can lengthen the attention span and the memory reach, increase the vocabulary, multiply discriminable differences, develop problem-solving techniques, accelerate directness in creative work, and in scores of other ways modify the mind and its complicated mechanisms of expression. What comes of such self-organization and regimentation when we reach older years? Is there any evidence to support the theory that our mental longevity will be appreciably influenced by the climb in psychological skills which we make early or moderately early in life and by the use-disuse ratio which we permit between our earlier and later decades? A modern court has ruled that, "less mental faculty is required to execute a will than to enter into any other legal instrument."³ Can man through the mental gymnastics and by the continuance of psychological wakefulness associated with professional or avocational activities insure himself with nature for something in late life better than mere disposing memory or testamentary capacity, important though that may be to a few interested persons? This general question I should like to help to answer.

THE OLD-AGE TEST

The attainment to old age is the most ancient and honorable physical-mental test performance known to the experience of man. As a test it is presumed to have a very respectable degree of reliability and irreproachable validity. The test is given under natural rather than artificial environmental surroundings and the population concerned is adequate. The results appear to be trustworthy and permissible of

³ N. Y. Sur. 1921. In re Tymeson's Will 187, N. Y. S. 330,114. Misc. Rep. 643.

broad generalizations; they are accepted by the majority, although being at the same time sharply criticized by smaller groups. The items which compose the test are mostly stock items which were selected long ago after a great deal of preliminary trying out of this material and that. There are slight variations of emphasis within the test from generation to generation but the general get-up and form of the examination appears to have remained much the same during the past few centuries in spite of the apparent danger from coaching. In fact coaching rather than being prohibited has come to be looked upon with socio-scientific favor.

Considering our problem in closer detail it is of course obvious that on the quantitative side we must not confuse old age with the year value for expectation of life at birth. The great change in life expectation as an average mortality value has been wrought in our statistics through the triumphs of medicine and public health in dealing successfully with problems of infant and child life risk. Richardson's⁴ recent study of inscriptions on 2,022 Greek sepulchers shows an average age at death of 29.4 years. Probably, due to burial customs, this value is somewhat higher than Hippocrates and Galen would have given us had they been interested in a statistical approach to these matters. Results compiled in Geneva for the 16th, 17th and 18th centuries respectively show, 21, 26 and 34 years as mortality averages. In Massachusetts just before 1800 the value was 35 years and by 1890 we find 43 years. In 1900 for the U. S. registration states it was 49 with an increase to 51 for 1910, and averaged 56.4 for 1920. Now 15 years later we appear to stand at 59.3 years for males and 62.8 for females. One does not have to be either a biometri-cian or an actuary to understand readily that any ascertained gain in average life expectancy is meaningful chiefly by interpretation in reference to life expectancy found in different portions of the theoretical human life-span. It is now generally agreed that practically all of the widely heralded change has occurred in the decades below 50. Those who reach the half-century mark to-day have practically the same chances of life and death as had their parents, grandparents, and perhaps their earlier ancestors. For example the expectation of life at age 52⁵ throughout our country holds almost as close to 21 years as does the percentage value for the oxygen content of outdoor air. It is a little less than 21 years for men of 52 and a little more for women of this age. The sex difference amounts to nearly a full year and appears to be statistically reliable. The progress

⁴ B. E. Richardson, "Old Age Among the Ancient Greeks," Baltimore, Johns Hopkins Press, 1933, p. 376.

⁵ R. H. Lyman, Ed. "The World Almanac and Book of Facts." New York, World-Telegram, 1934, p. 292.

difference measured in less than half-century steps is small and doubtful, possibly about three tenths of a year since 1900, and this gain some have credited to the hospital accessibility enjoyed by large urban groups. Progress in scientific medicine and hygiene presumably must influence the tenability of the older decades of the human life-span and we seem to be justified in believing there has been some progressive upward shift even though old literature said three score years and ten with sometimes four score, and to-day this same formulation fits the facts. Perhaps it is not inappropriate to compare the Greek data⁶ with the U. S. 1930 mortality tables. If we take the Greek cases recorded as dying at age 50 and older, a total of 332, the successive decades from the 6th to the 11th respectively show the following percentages: 38.0, 28.0, 19.3, 10.5, 3.3, and 0.9. The comparable percentage values for the United States in 1930 of persons 50 years and older are found to be: 23.0, 29.2, 29.8, 15.5, 2.3, and 0.2. The two series of values resemble one another. But the high point of death incidence in the Greek group falls in the 50's while for the recent Americans it is found between 60 and 79. The shift seems large enough to talk about, but it is not the time now to deal with this specific point in detail. The favorable shift that has occurred does not contradict the essential conditions leading to our conclusion that the long-life test continues in one generation after another to show a relatively unchanged mean score norm available in measurement and comparison and against which an x number of factors can be viewed.

LONGEVITY AS A MENTAL TEST

As psychologists the factors that occur to us as particularly interesting for study in reference to old age are those having to do with the intellect in its aspects of endowment, performance ability and with training and experience. Traditionally wisdom has been associated with age and various features of primitive as well as civilized culture patterns have contributed to confer distinction and leadership on the old. Genius and eminence rank high in actuarial folklore and perhaps if we could get at the basic facts they would still bear out the resultant popular belief. The life-spans of 115 eminent ancient Greeks classified according to primary fields of achievement show averages that surpass what seemingly was for the bulk of their countrymen usual. I will mention four professional groups for each of which the number of cases is not too trivial: 38 philosophers lived on the average to 78.8 years, 26 writers (poets) 79.3 years, 25 writers (historians, critics) 78.4 years, and 10 orators, 71.6 years. The average was 77 years and 45 per cent. of the group reached the 80-year mark. An earlier piece

of work than the study of Richardson on the Greeks was that by Cox⁶ on the 282 most eminent men born between 1450 and 1850. In that investigation it was found that 42 lived 80 years or longer, whereas within an average group of this size only 3 or 4 might be expected to reach that age. The 22 philosophers slightly surpassed 68 life years, 43 poets, novelists and dramatists and 23 religious leaders averaged just under 68 years; 52 historians, essayists and critics did not quite reach a mean life span of 64 years, while the group of revolutionary statesmen got off with about 51. The total average for the 282 geniuses was 65.8 years. Undoubtedly it is a fair question to ask how far long life pushes a man toward eminence. Given 100 men of equal ability the 50 who live longest should of course achieve greater average distinction. It seems very clear, however, in this comprehensive study of the 282 distinguished persons that mental accomplishments in early and mature years and not chronological longevity constitute the social criteria of greatness. Hence the correlation between age and achievement is the more meaningful. Outstanding mental grasp and strength makes its professional business that of working with and creating values from physical, biological and cultural materials but as a rule such strength does not neglect incidentally to pass the old age test with an appropriately high score.

Human century plants breed from capable common stock and themselves tend to be above average in capability. Primitive environment and lack of education may have handicapped them in many instances, but it is not unreasonable to believe that mental alertness has survival value and will be found to correlate positively with those somatic and functional traits of skeleton, heart, endocrines, nervous system and so on which make for "long lasting." I am not acquainted with any more significant data on this phase of our topic than those published fifty years ago by Humphry⁷ who with the aid of many interested British physicians secured information concerning nearly nine hundred persons who had attained the age of eighty years, including seventy-four centenarians. Intellect and memory constituted two of the several topics studied in these populations selected only for age. Discussing the then "present condition" of a group of fifty-two centenarians the statement made was: Intellect—forty-six returns, high 11, average 29, low 5, childish for 6 years 1. One was said to be slow in comprehending questions, but smart in reply. Memory: (a) recent events, thirty-nine re-

⁶ C. M. Cox, "The Early Mental Traits of Three Hundred Geniuses," Vol. II, Genetic Studies of Genius, Stanford University Press, Stanford Univ., Calif., 1926, pp. 35-36.

⁷ G. M. Humphry, "Old Age," Cambridge, MacMillan and Bowes, 1889, pp. 218.

turns; good 26, moderate 7, bad 6; (b) past events—forty-seven returns; good 39; moderate 4, bad 4. "One remembers and will quote a great deal of the Bible, another could repeat about 100 Psalms correctly." The temptation to give more of Humphry's results is great. What I have included are typical and I think significant. High ratings of intelligence exceed low ratings in the ratio two to one or better. We know from the rather recent experimental work on the course of the intelligence score curve in adulthood⁸ that the correlation between age and score from the age of 20 to 95 years in homogeneous population is usually about - .40 in speed tests and - .30 where speed is not involved. The difference between the average scores in the twenty-year group and in the eighty-year group in a timed test is near 10 times the sigma of the difference. The drop between age 18 and age 85 is possibly 60 per cent. of the peak score amounting to fully 5 mental age years. When an old person is judged to be of average adult intelligence, unless we must allow for a very large chance error in the judgment, it is a fair assumption that his or her intelligence in early adulthood would have rated considerably above average. If we take this into account in reference to Humphry's findings for intellect in advanced age the significance of the findings appears to be increased and they are seen to conform the more strikingly with the long life trend found among men of eminence and genius.

THE INTELLIGENCE-EXPERIENCE PARTNERSHIP

I have spoken of the correlation between human superiority and longevity in undoubtedly too simplified a formulation and the statements at this stage represent more a point of view than a fully demonstrated scientific finding. The nature-nurture knot is no less tight and stiff here than elsewhere. Professional groups, including, for example, judges, clergymen, and physicians show remarkably prolonged active careers and in insurance circles are termed preferred risks. The word "professional" implies training and practise of a high order as dominant features which characterize a type of life or of human being. From a multitude of psychological and educational studies we are convinced that those who present themselves as candidates for and who successfully carry through prolonged intensive professional training are at least of high average and more usually of superior intelligence. Mental endowment plus training constitute the effective partnership which through practice functions with such outstand-

⁸ C. C. Miles and W. R. Miles, "The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity," *Amer. Jour. Psychol.*, 44: 44-78, 1932; C. C. Miles, "Influence of Speed and Age on Intelligence Scores of Adults," *Jour. Gen. Psychol.*, 10: 208-210, 1934.

ing efficiency in the professional groups in comparison with the general population averages. We do not wish to dissolve this partnership, that would be perilous. We are curious to know who is who among the active directors and if practise is more than a well-trained shipping clerk. Anecdotal-descriptive treatments of what might now be called the ability-practise-age problem have been many particularly if we turn to the biographical and autobiographical literature. On the other hand, scientific psychology has been slow to follow the lead of Galton in attempting laboratory measurements with adult age as the chief variable. Only within the last decade have such studies begun to appear in our experimental literature and there are scarcely more than a dozen of them to date. It has been a real triumph to win the cooperation of men and women in all decades of life and I feel that my own research, the Stanford Later Maturity Study,⁹ is distinguished by reason of the cooperation of older adults. More than 300 people 70 years of age or older have come to our testing laboratories to be tested and studied. There is a thrill in the realization that a new and important human territory is opening for scientific exploration and therefore to some extent we may believe, for better scientific control. So far the psychological experiments conducted on the influence of adult age have been attempts to measure the ratio between scoring ability and age along various strategic psychological arteries. Attention has been centered on the measurement and the correlations rather than on the populations. The experiments could not be set up specifically to emphasize the relative influences of native ability and of experience until the normative data were gathered. However, even in the exploratory stage there appear some experimental results which may be examined from this angle of interest as indicators of probable trends and of points of attack for further investigation.

MOTILITY AND MOTOR FUNCTIONS

Physiological age exacts its tax year by year as the individual grows older; but psychological age adds to the personal capital stock of experience and bonds of association as real assets to be drawn upon. The presence of so-called senile tremor in its early unexaggerated stages is no doubt an annoying inconvenience. But as may be commonly observed there is a conspicuous lack of disability in consequence of it. Fine manipulations of the fingers as in sewing, writing or the use of instruments, even those of precision, are continued with great skill by many who have quite observable tremor. Even though loss of quickness and

⁹ W. R. Miles, "Age and Human Ability," *Psychol. Rev.*, 40: 99-123, 1933. These studies have been supported by the Carnegie Corporation of New York.

accuracy in leg coordinations may serve to retire a 40-year old baseball player from the big leagues it is none the less true that in many of the motor functions the decline from a peak which may have occurred in the 20's or 30's is slow and apparently considerably retarded through the effect of occupational or other practise engaged in by the mature individual.

The influence of training and practise, the psychological assets, upon the physiological motor functions, is well illustrated with respect to a complicated skill in performance in the sport of trap-shooting, where not a few of the nationally famous expert champions are men considerably beyond middle life. Recently I have examined some data for 400 trap-shooters including their scores at a national tournament in 1932 gathered by Mr. Edward Pugsley, of the Winchester Repeating Arms Company. The scores measure visual reaction time by use of an electric circuit with a flashlight target, a chronograph and a gun. The ratings used are based on the first four reaction shots. A group of 28 trap-shooters in Class AA with an average age of 44.5 years averaged 191 sigma while 43 Class A men averaging two years younger, that is 42.3 years, gave the less good report of 198 sigma. Of more significance for our present problem than distinguishing between AA and A classes of trap-shooters is the matter of the regular relation of age to performance skill and here, in general, decrement does occur. One hundred and seventeen men whose ages were known to be between 20 and 49 inclusive gave an average reaction time of 200 sigma as compared to the average of 209 sigma for 58 men aged 50 to 85 years. All of the mean values are just a little higher for the older group, the reaction times averaging about 4.5 per cent. longer. For 33 trap-shooters aged 40 to 44, the average is 203, and for 26 aged 50-54 it is 206. But in the very young group the trend is reversed: 13 young trap-shooters from 10 to 19 years of age competing in this national tournament average 246. The extraordinary contribution of the trap-shooting test is in the example it provides of the counterbalancing effect of the psychological elements of skill, practise and experience upon the inevitable physiological ravages of age. Neither Galton's data gathered in 1884 and recently analyzed and published by Ruger¹⁰ nor my own in the Stanford Maturity Research nor that of any of my associates duplicate this particular good example of the weight of experience counterbalancing the weight of years with respect to a motor skill. I believe that similar examples will be found in the realm of the skilled trades and occupations where men with zest and interest really exert themselves on materials and

in tasks with which they are familiar. Trap-shooting is unique only in being highly standardized and scorable. Results from laboratory measures of motor functions elaborate and substantiate the interesting trap-shooting findings. Series of tests of speed of movement where the mental organization element is slight show the age decrement as fairly large; when the test includes the elements of selection and adjustment of the movement or movements with respect even to some fairly familiar or easy task, experience reduces the decrement. For example, in the simplest movement of the index finger of the preferred or dominant hand, that is, lifting the finger off a key and pressing it down again, shows a marked decrement with age. The much more complicated task of opening three ordinary letter size envelopes with a paper knife on the other hand shows less change with age. The correlation coefficients for these two contrasted functions for large groups of persons 20 to 90 years of age are $- .57$ for simple speed of movement, $- .46$ where a planful use of experience is even so slightly involved as in the task of letter opening. Well-practised complicated skills and especially those which do not tax strength too severely show the best degree of retention among the motor functions and here with thoughtful planning a great contribution to mental longevity may be made.

SENSORY AND PERCEPTUAL FUNCTIONS

An old English proverb says that no agricultural laborer who is more than forty years old can hear a bat squeak. I am not aware that Galton made any calibrations on bats but with his famous whistle he did verify the effects of the auditory decrement with age. From his data as published by Ruger on 3,816 men, ages 25 to 81, a recently calculated correlation coefficient for age with highest audible pitch gives $r = - .482 \pm .008$. That our eyes tend to grow old rather early has been more generally remarked than has the downward course of the hearing function. Decreases in accommodation power and in visual acuity are among the first harbingers of age to which we give heed. Here Galton's adults, 3,850 men, ages 25 to 81, show a negative correlation of age with visual acuity, $r = - .512 \pm .008$. The results which more recent investigators have gathered in their laboratories closely agree with the trends indicated by these coefficients and show that we are, so to speak, up against an inexorable law of decline with respect to the simple physiological sensory functions. Fortunately ophthalmology and autology have come to our aid and we may expect the development of further mechanical techniques to supplement practically the slight preventive and remedial measures that may be applicable to sensory age-decrement. A tomb in

¹⁰ H. A. Ruger and B. Stoessiger, "On the Growth Curves of Certain Characters in Man (Males)," *Ann. Eugen.*, 1927, 2, Pts. I and II, 76-110.

Florence bears an inscription which reads: "Here lies Salvino degli Armati, Inventor of Spectacles. May God pardon his sins." Although this sentiment is a little ambiguous I take it to indicate human gratitude to one who helped us in the more effective use of these functions in which we are little able to help ourselves.

When the sensory functions are employed in tasks more complicated than mere acuity tests, with opportunities for interpretation of content and meaning, the psychological factor enters and the results are less unfavorable for age. That is, the situation here is parallel to that mentioned in the field of simple motility as compared with more complex motor functions. In a tachistoscopic study of perceptual ability where letters, digits, words, sentences, colors and simple diagrams were employed as content by which to measure the amount grasped in a single visual exposure it was found that the correlation of perceptual score with age was $-.43$ which is considerably lower than the decrement coefficient for visual acuity and age. Then when the same subjects were tested for speed of reading a standard passage the coefficient became still smaller, reaching a value of $-.27$. From these and other similar results it seems that familiarity or naturalness in the test situation together with a degree of complexity which gives scope for individualized mental technique operates for an increase in scoring power in mature and older adults.

Perception in the old as compared with the young, although not as prompt or as great in span, is frequently joined with the quality of perseverance or persistence in consecutive efforts. This results in relative evenness of performance, a point for which old age should and often does receive due credit in industry. It appears to be a modification referable to practice and through it a broadening of perceptual interest can be achieved.

LEARNING AND MEMORY

Blurred memory like blurred vision is frightfully conspicuous to him who has it. And as to the relation between memory and mental longevity doubtless many hold with Longfellow,

"Whatever poet, orator, or sage
May say of it, old age is still old age."¹¹

But actually the annoyance and frustration caused by slight forgetting may be subjectively quite exaggerated and out of proportion to the actual amount of defect. Furthermore we may observe that it is a popular and wide-spread conversational habit among middle-aged people and even some adolescents as well as among the old to make disparaging remarks con-

¹¹ H. W. Longfellow, "Morituri Salutamus."

cerning their own memories. These faithful and hard-worked functions are talked about with the same unsympathetic objectivity and blatant candor that was once used in discussing cooks or maid servants. For a kinder and probably truer picture we may look again with profit to Humphry's data.¹² In his analysis of the returns relating to 340 males and 282 females 80 to 90 years of age we find that memory for past events is reported good in 82 per cent. of the men and 73 per cent. of the women, moderate in 11 per cent. of the men and 16 per cent. of the women, and bad in only 7 per cent. of the men and 12 per cent. of the women. Memory for recent events is reported as follows: good, men 64 per cent., women 54 per cent.; moderate, men 21 per cent., women 26 per cent.; bad, men 15 per cent., women 19 per cent. No comment need be made on what I am content to believe may be an unreliable sex difference here except to suggest that the matter of occupational necessity may bring practise more favorable to the men. My point is that memory function is not universally bad or even moderately bad among older people. To be sure, on the average, memory shows some decrement with age as we have measured it in successive decade groups of different individuals, but the memory decrement is not larger than that usually found for other mental functions. A straightforward memory task involving familiar material or concepts may be counted on to yield a negative correlation with adult age of about .40. However, if the material consists of nonsense syllables or involves mastering relations that are contrary to established mental associations the coefficient is more likely to be approximately $-.60$. Ruch¹³ in one of the Stanford Later Maturity Studies has dealt especially with this matter of practise and memory as it relates to the use of previously familiar material. His results agree with those of Willoughby, Jones, Conrad, and Horn, and with Thorndike, Bregman, Tilton and Woodyard¹⁴ in finding that the meaningful previously acquired content items could be learned with much less age deficit than was found for extensively reorganized or nonsense material where long-established mental association habits operated as interference to learning. When, in studies of adult learning, we classify the men and women in terms of the amount of formal schooling in three groups: college, high school and grade school, the three resulting sets of results fall in line with what we may suppose correspond to three grades of

¹² *Ibid.*, G. M. Humphry.

¹³ F. L. Ruch, "The Differentiative Effects of Age upon Human Learning," *Jour. Gen. Psychol.*, 11: 261-286, 1934.

¹⁴ All summarized in W. R. Miles, "Age and Human Society," Ch. 15, C. Murchison (Ed.), *Handbook of Social Psychology*, Clark University Press, Worcester, Mass. In press.

training for practise. For example Price¹⁵ with a reliable directions test, making use of immediate memory, found a correlation coefficient of $-.51$ and a regular point score decline per decade of 6.7 in the college population, 7.1 for the high school population and 9.6 for adults with grade school education. The greater decrement at the lower educational level must be in part a function or a correlate of less general ability, but the influence implied in experience is also demonstrated by individual differences within the three groups.

INTELLIGENCE AND AGE

The direct and positive relationship between human intelligence and chronological age during childhood and youth has probably always been obvious to man and was not difficult to demonstrate scientifically after appropriate tools had been developed for working with mental performance ability. In contrast adult minds have typically been thought of as continuing relatively unchanged except in accumulation of experience for several decades just as the skeleton of the adult having completed its growth was thought to undergo only slight modifications until the active processes of senile change set in late in life. Relatively few have had the insight and the temerity demonstrated by Montaigne when he said, "For my part, I believe our souls are adult at 20 as much as they are ever like to be, and as capable then as ever. . . ." Here he inserts a quotation, "if the thorn prieks not when it first shoots, it hardly ever will at all," and then continues. . . . "Of all the great human actions I ever heard or read of, of what sort soever, I have observed, both in former ages and our own, more performed before thirty than after; and oft times in the lives of the same man. . . . As to myself, I am certain that since that age both my understanding and my constitution have rather decayed than improved, retired rather than advanced. 'Tis possible that, with those who make the best use of their time, knowledge, and experience may grow up and increase with their years; but vivacity, quickness, steadiness, and other qualities, more our own, of much greater importance, and much more essential, languish and decay."¹⁶ This mental dissection by Montaigne cuts rather too close to the quick for comfort and rather hastily discards much that might be called supporting mental structure. However, even though as individuals we may be loathe to admit it, since self-evident decline is not usual, still our practical experience does show that many perhaps most of the easily measurable

human capacities decline with respect to the compound quantity-quality output after we pass middle age and before we have reached old age. Serious scientific work in this field has only recently begun and the preliminary data so far published comparing the various psychological abilities throughout the life span are almost entirely based upon measurements of different individuals within the decades and semi-decades where comparison is made. Quite regularly it has been found that the maximal scoring ability occurs between the ages of 18 and 49 whether the test be of general intelligence or of a more restricted aspect of mental activity. Performance tasks which strongly emphasize the factor of speed somewhat penalize the old but tests given with unlimited time seldom fail to show some progressive decrement throughout the last four or five decades of life. The correlation coefficients found between scoring ability and age for the range from 25 to 95 years extend from small plus or nearly 0 values to minus $.65$ with the usual correlational value falling near $-.3$. Not all measurements thus far taken show a clearly continuous decline from the late 20's to the early 90's. For some there is a fair plateau until perhaps the late 40's or early 50's. For others there is scarcely any change even in advanced age.

We may survey briefly some of the experimental results for adult age which have been found in this broad field of judgment and reasoning which we call intelligence. Let us examine first some of Galton's measurements.¹⁰ He had in all seventeen, which included three judgment tests: (1) sense of perpendicularity, error measured in degrees; (2) error of bisection; and (3) error of trisection, in both of which the score was in percentage of the length, bisected or trisected. The published data include about 3,815 cases with age range between 25 and 81 for each of the three. The correlations between age and score turn out most interestingly to be practically zero: perpendicularity $+.058 \pm .011$; bisection $+.071 \pm .011$; and trisection $+.033 \pm .011$. Clearly, with this type of task which closely approximates the activity involved in the fundamental spatial judgments of adult life there is no decrement with increased adult age. And yet these judgments correlate decidedly with intelligence and we know that the feeble-minded or the very young can not make them. Results for similar functions show similar results in the more recent Stanford Study. From these we may turn to a kind of test in which experience varies more profoundly and practical as well as theoretical intelligence is measured. The Stanford battery of 1932 included the McFarland Coat Assembly Test (by snaps a complete garment is to be put together from 9 pieces) and a painted block assembly test (a painted 3 inch cube

¹⁵ B. Price, "A Directions Test Arranged as an Interview and a Determination of Adult Age Effects Therewith," Stanford Univ., Calif., 1933. Unpub. Ph.D. Thesis.

¹⁶ M. de Montaigne, Works, New York, 1872. Vol. I, "Of Age," p. 467 ff.

that has been cut into 1 inch cubes has to be reassembled). What happened in the case of the coat test? The men showed the usual decline with increasing age, the women did not. For them the influence of experience was so usefully complete that even though the garment design was novel they succeeded about equally well decade by decade up to the 70's. On a repetition of the task the women made relatively less gain than the men for they were already nearer their physiological limit of speed, and insight due to experience had been present from the first. The men made a great improvement on the second trial; for them the experience and practise of the first trial was unique and therefore highly important. In the block test the situation was not reversed, the women showed a less good performance but also less age decline than the men. Actually, as indicated by the two coefficients: for the women $r = -.330 \pm .03$; for the men $r = -.435 \pm .029$. Putting together a series of blocks isn't mechanical enough to baffle the average woman but a group of men in the 50's and 60's with experience in mechanical fields exceeded other men of the same ages and equal general schooling by a difference that is 2.5 times its standard error.

Coming now directly to what are generally called intelligence tests we find that the scores for the Otis Omnibus Test continue to show in one population after another the same age decline and the same experiential retardation in this decline that appeared in our first study. But when the test is broken up into its elements by functional type into verbal, reasoning and mathematical items and when we sort the responses of four hundred men and women representing all the adult life decades we find a differential scale of decline with age from the least to the most affected of these three general types. Representative samples from several tables of correlations will illustrate the trends. For men and women of the general population (combining those of grade school and high school education) the correlation coefficients of scores with age from 25 to 90 years run as follows: Synonym-Antonym, +.013; Vocabulary, -.043; Analogies, -.105; Logical Selection, -.091; Proverbs, -.164; Arithmetical Problems, -.237; and Number Relations, -.262.

This finding that language functions, examined differentially, are relatively impervious to old age change and represent basic assets for mental longevity has been demonstrated by other investigators also. Clinical medicine has always counted on the language function in its patients. Hollingworth¹⁷ in 1920 pointed out that the old succeed well in tests of completion, opposites and word-building; Thorndike¹⁸

¹⁷ H. L. Hollingworth, "Psychology of Functional Neuroses," New York, Appleton, 1920, pp. 259. See Ch. 12, pp. 187-199, "Mental Ability and Chronological Age in Adults."

and associates have more recently amassed further data in these matters in their study of learning; and Babcock's¹⁹ use of their present vocabulary in estimating the earlier intelligence of deteriorated patients is a practical application of this finding based on further corroborative data.

At present no definitive answer can be given to the question of how large a rôle is played by training and practise in producing the decline differential between language and reasoning. If reasoning and arithmetic as representatives of types of mental function were practised as continuously as language tends to be they too might show a slim and trim correlational figure. Of course what we actually believe is that in many an individual such practise and such substantial fruits of practice are to be found hence the great amount of individual difference which is present in the period of later maturity.

OLD AGE A TEST OF PRACTISE

Brightness and dullness, experience and inexperience, mutually enhance each other in this world of human affairs. He would be stupid indeed who tried to abolish one or the other in any of these pairs. If into a fire-fly is injected a little adrenin he quits being intermittent and remains illuminated all night long. But the treatment is not supposed to be of benefit to the fire-fly. I have not discovered any psychological adrenin to change our human mental intermittey and deficiency into steady powerful light and most of us would quite properly hesitate to be inoculated were the substance at hand. It is neither the elimination of contrast among men nor an unchanging plateau in our own experience that we seek. The final orientation of my thesis to-night will be clearer if I remind you that just fifty years ago our eminent chairman Dr. James McKeen Cattell invented the term "individual differences" and published the first experimental psychological studies devoted to the subject.²⁰ In this jubilee year of that epochal event in scientific psychology I am glad to affirm my belief in the basic importance of this great principle. My thesis to-night is that training and practise account for a large amount of that considerable gain which is possible to each one of us, from year to year, within the range from less to more that represents

¹⁸ E. L. Thorndike, E. O. Bregman, J. W. Tilton and E. Woodyard, "Adult Learning," New York, Macmillan, 1928, pp. 335.

¹⁹ H. Babcock, "An Experiment in the Measurement of Mental Deterioration," *Archives of Psychol.* (New York) 1930, 18: No. 117, pp. 105.

²⁰ J. McK. Cattell, "The Inertia of the Eye and Brain," *Brain*, 8: 295-312, 1885. See the last paragraph. Note the objective non-introspective character of this early psychological paper.

our own natural minimum or maximum potentiality. It is this modifiable or extensible aspect which, contributing to the individual differences, found among men and women of mature and late age provides the most practically controllable and definitely trustworthy psychological insurance and affords the most probable prospect of mental longevity.

I therefore conclude by quoting the closing sentence in the paper of 1896 by Cattell and Farrand,²¹

"There is no scientific problem more important than the study of the development of man, and no practical problem more urgent than the application of our knowledge to guide this development." The study of man in maturity shows that his psychological progress is not bound utterly to the lowest level of his physiological decline. Through appropriate training and practise, continued mental elasticity and organized effective control, may extend mental longevity.

OBITUARY

NATHANIEL LORD BRITTON¹

THE Board of Managers of The New York Botanical Garden desires to place on record the following minute in regard to the passing of Nathaniel Lord Britton, which occurred on June 25, 1934:

The history of The New York Botanical Garden is inseparably interwoven with the name of Dr. Nathaniel Lord Britton. In originating and developing the idea of a great institution in the City of New York, to be devoted to the study of the plant sciences and to the public display of plants and plant products of scientific, economic and horticultural interest, the time and the place most fortunately met the man who possessed the rare qualities that could guide this ambitious undertaking to distinguished success. Making a definite start with an act of the state legislature in 1891, incorporating The New York Botanical Garden, the project was steadily advanced until in 1895 the \$250,000 required under this act for its initial endowment had been raised by subscription, the Commissioners of Public Parks had set aside for the purpose 250 acres of land in Bronx Park (afterwards increased to 400 acres), and the Board of Estimate had appropriated \$500,000 for the erection of suitable buildings. During all this period of preliminary organization, Dr. Britton, with able associates, was the motivating spirit. A board of managers had already been elected, with Cornelius Vanderbilt as president, Andrew Carnegie as vice-president, J. Pierpont Morgan as treasurer, and N. L. Britton as secretary. Seth Low, president of Columbia University, accepted the chairmanship of the scientific directors, and an affiliation between Columbia University and the Botanical Garden was arranged. On June 17, 1896, Dr. Britton was elected director-in-chief of the garden, a post that he held with unflagging energy for a little more than thirty-three years. Retaining a connection with Columbia University as professor emeritus, he

soon exhibited an altogether remarkable ability in combining the qualities of a technical research worker with those of a practical administrator and a successful author of scientific books. Dr. Britton soon perceived that the West Indies and Central America offered a largely untouched field for exploration by systematic botanists as compared with the northeastern United States. He participated personally in no less than thirty expeditions to the West Indies, mostly at his own expense. The results of Dr. Britton's studies are recorded in very numerous publications, of which some of the principal ones are the "Illustrated Flora of the Northern United States and Canada" (three volumes—with Judge Addison Brown), the "Manual of the Flora of the Northern States and Canada," "North American Trees" (with Dr. J. A. Shafer), the "Flora of Bermuda," "The Bahama Flora" (with Dr. C. F. Millspaugh), "The Caetaceae" (four volumes—with Dr. J. N. Rose), the "Botany of Porto Rico and the Virgin Islands" (two volumes, with Mr. Percy Wilson) and several important contributions to the "North American Flora." Dr. Britton was the leader in organizing and developing the "Scientific Survey of Porto Rico and the Virgin Islands," of which five volumes of the projected eighteen and eighteen parts of other volumes had been published at the time of his death. To this remarkable record of scientific achievement in the way of printed pages must be added the constructive leadership that resulted in a little more than a third of a century in building out of raw materials one of the leading botanical institutions of the world. In grateful recognition of the eminent services of Dr. Britton the Board of Managers adopts the following resolutions:

Resolved, That the Managers of the New York Botanical Garden deeply deplore their loss in the death of Doctor Nathaniel Lord Britton, their Secretary from March 21, 1895, to August 1, 1929, and Director-in-Chief of the Garden from June 17, 1896, to August 1, 1929. Doctor Britton combined to a remarkable degree the social, administrative, and scientific qualities that were

²¹ J. McK. Cattell and L. Farrand. "Physical and Mental Measurements of the Students of Columbia University." *Psychol. Rev.*, 3: 618-648, 1896.

¹ Minutes of the Managers of the New York Botanical Garden and of the Council of the New York Academy of Sciences.

requisite for the development of an institution of the kind proposed, and his success in little more than thirty-three years in placing The New York Botanical Garden in the forefront of similar establishments fully justified the wisdom of the choice. It is doubtful if any one else could have been found who would or could have attained similar eminent success in the existing circumstances. The New York Botanical Garden is, in a very real sense, a living monument to Nathaniel Lord Britton. Possibly his printed pages may endure even longer.

Resolved, That the foregoing preamble and resolution be entered on the official minutes of the Board of Managers and that copies thereof be sent to the surviving brother and sister of Doctor Britton, with assurances of profound sympathy in their bereavement.

The Council of the New York Academy of Sciences desires to place on record the following minute in regard to Nathaniel Lord Britton, whose death occurred on June 25, 1934:

Dr. Nathaniel Lord Britton was one of the oldest and most active members of the New York Academy of Sciences, having been elected to membership in 1880, at the early age of 21 years, and becoming fellow in 1884, patron in 1901, president in 1906 and 1907 and benefactor in 1918. In December, 1890, he proposed to the council a plan for the alliance of the numerous special scientific societies that had grown up in New York, and a few months later the Scientific Alliance of New York was fully organized. Sixteen years later the component societies of the alliance were affiliated with the academy. In spite of his absorbing duties for thirty-three years as the first director-in-chief of The New York Botanical Garden and his tireless activities as author of many voluminous works on botanical science, he always maintained a keen interest in the work of the academy and gave freely of his time and means to its support. In December, 1915, he suggested to the council the celebration, in 1917, of the one hundredth anniversary of the founding of the Lyceum of Natural History, the forerunner of the academy. Owing to the involvement of the United States in the world war, the ambitious plan for such a celebration was modified and partly abandoned, but there remained a Centennial Fund for the endowment of the academy, to which fund he was the largest contributor. In 1913, largely under the leadership of Dr. Britton, a proposition for a scientific survey of Porto Rico was approved by the council and a special committee of five, with himself as chairman, was appointed to organize and develop the project. The scope of this survey was later extended to include the Virgin Islands. At the time of his death, five of the contemplated eighteen volumes of the reports of the scientific survey, together with eighteen parts of uncompleted volumes, had appeared. Nothing comparable has ever been published for any

other of the West Indian Islands. The cost of the publication of the botanical volumes of these reports was underwritten by Dr. Britton himself. His personal popularity in political and educational circles on the island was in a large measure responsible for generous appropriations by the Government of Porto Rico for defraying the costs of other volumes.

In his last will and testament, Dr. Britton gave final proof of his devotion to the work of the academy by bequeathing to it, without conditions, a one twelfth share in his residuary estate.

In grateful recognition of the loyalty of Dr. Britton to the New York Academy of Sciences, the council adopts the following resolutions:

Resolved, That in the passing of Doctor Nathaniel Lord Britton, the New York Academy of Sciences has lost one of its most eminent members and one whose constructive leadership will be greatly missed, even though his foresight and devotion have assured that his generous support of scientific research and publication will long continue. And

Resolved, That the foregoing preamble and these resolutions be spread upon the minutes of the Council and that copies thereof be sent to the surviving sister and brother, with assurances of the deep sympathy of the Council in their bereavement.

RECENT DEATHS

GEORGE ANSON HAMILTON, of New Jersey, an honorary and charter member of the American Institute of Electrical Engineers and a retired consulting engineer of the Western Electric Company of New York, died on January 10, at the age of ninety-one years.

EDWARD C. HOLTON, chief chemist for the Sherwin-Williams Paint Company, died on November 30, at the age of sixty-nine years.

DR. ROBERT C. BURDETTE, associate entomologist for the New Jersey Agricultural Experiment Station at Rutgers University, a member of the station's staff since 1928, died on January 6, at the age of thirty-six years.

DR. FREDERICK AUGUSTUS DIXEY, formerly bursar and lecturer of Wadham College, Oxford, and curator of the Hope entomological collections, died on January 17, at the age of eighty years.

PROFESSOR GRANDCLAUDE, the assistant director of the Cancer Clinic of the Northern Departments at Lille, died of blood poisoning contracted in his hospital work on December 26, at the age of forty-three years.

PROFESSOR CHIYOMATSU ISHIKAWA, honorary professor of zoology at the Tokyo Imperial University, died at the age of seventy-four years on January 17, in Taihoku, Formosa, Japan.

SCIENTIFIC EVENTS

CONGRESS FOR PREHISTORIC RESEARCH IN THE FAR EAST

ARRANGEMENTS have been completed for a meeting at Manila of the second Congress for Prehistoric Research in the Far East—officially known as the “Deuxième Congrès des Préhistoriens d'Extreme Orient”—which will be held under the joint auspices of the University of the Philippines and the Bureau of Science, from February 6 to 12.

Governor-General Murphy recently invited the governments of Japan, China, French Indo-China, Siam, Netherlands Indies, Hongkong, the Federated Malay States and British Borneo to send official delegates to the congress. It is understood that the following institutions will also be represented by one or two delegates each:

The Oyama Institute of Prehistory, Tokio; the Universities of Tokyo, Sendai and Kyoto, Japan, and the University of Taihoku, Formosa.

The Geological Survey and the National Research Institute, of China, both at Peking.

The University of Hongkong.

Ecole Française d'Extreme Orient, and the Geological Survey of French Indo-China, both at Hanoi.

The Royal Siamese Institute of Literature, Arts and Archeology, Bangkok.

The Batavia Society of Arts and Sciences, and the Bureau of Anthropology for the Netherlands Indies, Java.

The Bishop Museum of Honolulu, and The Federated Malay States museums at Taiping and Singapore.

This congress was originally scheduled to be held at Bangkok in January, 1935. Disturbed political conditions in Siam, however, and recent changes in the government there, caused the executive committee of the congress to transfer it to Manila, and to postpone the date until February.

The Philippines will be represented by three delegates at the congress—one from the university, one from the Bureau of Science and one representing American students of Far-Eastern prehistory.

Leading archeologists and students of the ancient history of the Far East, as well as a number of geologists and explorers, have already signified their intention of attending.

Some of the principal features of the tentative program are:

1. Reviews of recent prehistoric and protohistoric research in China, Japan, Formosa, Hongkong and vicinity, French Indo-China, Siam, the Malay Peninsula and the Netherlands Indies, the Philippines and the Pacific Islands; by one delegate from each of these regions. (For the delegates and associate members only.)

2. Three or more open meetings, at which papers of

general interest, relating to recent discoveries in the Far East, will be read.

3. A series of round-table conferences, at which special topics will be taken up by small groups of interested delegates and associate members.

The proceedings of the second congress, and the more important papers read, will be later published—probably in a volume to be issued by the university or the Bureau of Science some time before the end of 1935.

It may further be stated that the congress was an outgrowth of the Pacific Science Congress, and was originally organized in connection with the Java meeting of that congress in 1929–30. The first independent meeting was organized by the Government of French Indo-China, Hanoi, 1932.

H. OTLEY BEYER,
Chairman, Philippine Committee

THE THIRD INTERNATIONAL CONGRESS OF SOIL SCIENCE

THE third International Congress of Soil Science will be held at Oxford, England, from July 30 to August 7, this year under the presidency of Sir John Russell. The two previous congresses of the series were held in Washington in 1927 and in Leningrad and Moscow in 1930, and were notable for the exceptionally international character of the personnel and the discussions. The congress will meet as a whole in six plenary sessions, at which a general survey of recent advances in every branch of soil science will be made, and it will also work in sections or “Commissions” dealing specifically with soil physics (I), chemistry (II), biology (III), fertility (IV), classification (V) and technology (VI). Three sub-commissions will discuss problems relating to alkali, forest and peat soils, respectively. A 16-day excursion round Great Britain leaving Oxford immediately after the congress, and terminating in Cambridge on August 23 is being arranged for the benefit of members wishing to obtain first-hand knowledge of British agriculture and soils.

Every member of the congress will receive a copy of the official transactions, including the full text of papers read at the plenary sessions, and detailed reports of the discussions at the commission sessions. The cost of the *Transactions* will be included in the Congress fee (£2), payment of which will also entitle members to attend all meetings, receptions, etc., held in connection with the congress. Accommodation during the congress in an Oxford College may be reserved through the organizing committee, or privately in hotels or boarding houses.

Intimation of attendance at the congress should be

sent as soon as possible to the Secretary of the Organizing Committee, G. V. Jacks, Imperial Bureau of Soil Science, Harpenden, England, from whom all further information may be obtained.

REPORT OF DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

DR. E. D. MERRILL, director of the New York Botanical Garden, pointed out to members of the board of managers at the annual meeting on January 14 that naturalistic planting of tropical subjects in the greenhouses has been one of the important horticultural developments at the New York Botanical Garden during the past year.

The cactus house in Conservatory Range 1, which has been closed to the public for several weeks, will be re-opened this month, with all the plants set out in a desert garden as though they were growing out of doors in their native habitat. Other succulents, which were planted in naturalistic fashion in the adjoining house last year, have grown luxuriantly. In early spring, the collection of bananas and their allies will be on view in a humid, tropic house where they are now being replanted.

Bordered with suitable shrubs, trees and smaller plants from cooler regions of the world, a new rock-bound pool has replaced the old formal pool at the entrance to Conservatory Range 2 on the east side of the grounds. Collections of orchids and begonias, two of the featured types of plants in other parts of this conservatory, have been greatly improved the past year.

In anticipation of a magnificent display of flowers in the new Thompson Memorial Rock Garden, 7,500 bulbs for early spring bloom were planted last fall. These will be seen in addition to hundreds of primulas and other flowers which were first brought into bloom there last spring.

A gift of 450 evergreen trees received from Colonel Robert H. Montgomery has been used largely for new background plantings. In addition, Colonel Montgomery presented 85 species and varieties of evergreens which are now being raised for the garden at the Boyce Thompson Arboretum.

Ornamental trees and shrubs figured largely in a gift of a carload of nursery stock—1,445 items—from the Farr Nursery Company of Pennsylvania. The trees in the natural hemlock forest bordering the Bronx River at the Botanical Garden have been increased by the planting of 300 specimens four to five feet high. Other new plantings include the borders of the park, where work has been done partly in co-operation with the city, which has provided the means for improvements in many parts of the grounds.

A body of women workers from the Emergency Relief Bureau has helped the New York Botanical Gar-

den to build up, in the last few years, one of the largest and most readily accessible collections of herbarium specimens in the world. While two or three other herbaria slightly exceed the New York one in size, none has so efficient a system of references.

The Botanical Garden's herbarium, with 70,000 specimens having been mounted and added to the collections by emergency workers during 1934, now numbers 1,800,000 specimens.

Dr. Merrill also announced that the year's additions to the library bring the number of bound volumes above 44,000, enabling it to hold its place as the largest combined botanical and horticultural library in America.

The course for professional gardeners, inaugurated in 1932 by the New York Botanical Garden, entered its third year last fall with a record enrollment of seventy-two students. Gardening courses for amateurs, courses of study on ferns and trees, and Saturday afternoon lectures given in all but the summer months have been among other educational activities. Scientific work prosecuted during the year has included the study of specific plant diseases and their control, and the breeding of new varieties of day lilies, southern iris and lilies, besides the work on seedless grapes being carried out in cooperation with the Geneva Experiment Station.

Many improvements in buildings and grounds have been initiated with the help of men from the Emergency Relief Bureau. Among other workers from this group in the Museum Building, there have been artists, librarians, technicians, stenographers, typists, clerks, and others, who have been of great assistance to the scientific staff.

An innovation in memberships approved at the meeting is a garden-club membership, by which a group, for an annual fee of \$25, is accorded special privileges offered by the institution.

FELLOWSHIPS IN MEDICINE OF THE NATIONAL RESEARCH COUNCIL

FELLOWSHIPS in medicine, administered by the Medical Fellowship Board of the National Research Council, will be available for the year beginning on July 1. These fellowships are open to citizens of the United States and Canada who possess an M.D. or Ph.D. degree. They are intended for recent graduates and not for persons already professionally established.

The fellowships are designed to provide research discipline for men and women who are fitted for research in the medical sciences. At present candidates will be favored who plan to specialize in one of the sciences related to medicine or to approach clinical medicine and surgery through temporary identification with one of these sciences.

The choice of place to work in is left to the fellow, subject to the approval of the Fellowship Board; but as a rule fellows will be expected to work in this country. Ordinarily before sending his application to the board, a candidate should have assurance from the person with whom he wishes to work that he is acceptable.

The appointments are for full time and no other remunerative work is permitted. The usual basic stipends awarded are \$1,800 a year for unmarried fellows and \$2,300 for married fellows.

Fellows will be chosen at a meeting of the Medical Fellowship Board in April. Applications to receive consideration at this meeting must be filed on or before March 1. Appointments may begin on any date determined by the board.

Further particulars concerning these fellowships may be obtained on request. All communications should be addressed to the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.

FRANCIS G. BLAKE, *Chairman*

DIVISION OF MEDICAL SCIENCES

NATIONAL RESEARCH COUNCIL

THE NEW DEAN OF THE YALE SCHOOL OF MEDICINE

DR. MILTON C. WINTERNITZ, whose term of office as dean of the Yale School of Medicine expires in June, has declined to be considered for reappointment. To succeed Dr. Winternitz, Dr. Stanhope Bayne-Jones, professor of bacteriology in the faculty of medicine, has been appointed dean for a period of five years beginning on July 1.

The following resolution, adopted at the January meeting of the Yale Corporation, was also made public:

To record the enduring gratitude of the President and Fellows to Professor Milton C. Winternitz for his outstanding services to the University and the New Haven Hospital during the fifteen years he has served as dean of the School of Medicine, and to express their hope that he may long continue his association with the community, and the University to which he has in his work made such notable contributions.

Dr. Winternitz, who is professor of pathology, came to Yale University from the Johns Hopkins University. He has been a professor in the Yale Medical School since 1917, was first appointed its dean in 1920 and has served as such for three successive five-year terms. From this country and abroad the following members have been added in recent years to its faculty: Professors J. G. Dusser de Barenne from Utrecht; John F. Fulton from Oxford; Eugen Kahn from Munich; Edgar Allen from the University of

Missouri; Walter R. Miles from Stanford University, and Harvey Cushing from Harvard University.

The physical plant of the school and of the New Haven Hospital, with which it is affiliated, has been practically rebuilt and greatly enlarged by gifts for these purposes from friends of the school and from some of the great foundations, resulting from the leadership of Dr. Winternitz. In addition he was one of the prime movers in the establishment of the Institute of Human Relations.

In general support of the program developed by Dr. Winternitz, the endowment of the School of Medicine has been increased from about \$2,000,000 to over \$8,000,000 by gifts made during his deanship.

Dr. Winternitz will continue his work in the school as professor of pathology.

Dr. Bayne-Jones, who is professor of bacteriology and master of Trumbull College, took his B.A. degree at Yale in 1910, and his M.D. at the Johns Hopkins University, where he studied under Dr. Winternitz. During the war he served as Medical Officer with the British Expeditionary Forces for ten months; later was with the Twenty-Sixth Division of the A. E. F., and finally with the rank of major as sanitary inspector of the Army of Occupation. He received the British Military Cross and the Croix de Guerre. He was associate professor of bacteriology at the Johns Hopkins Medical School from 1919 to 1923. He came to Yale from the University of Rochester where he had been professor of bacteriology for eight years. While there he was director of the Rochester Health Bureau Laboratories.

THE ROCHESTER MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA

THE forty-seventh annual meeting of the Geological Society of America was held at the University of Rochester, from December 27 to 29.

The meeting was one of the largest in the history of the society. One hundred and twenty-two scientific papers were presented before the Geological Society, and the programs of the associated societies meeting with it, the Paleontological Society and the Mineralogical Society of America, were also crowded.

The address of the retiring president, W. H. Collins, geology and literature, was delivered the evening of December 27, followed by the annual smoker. The annual dinner was held at the Hotel Seneca on the 28th. The seventh award of the Penrose Medal was made at the dinner, the recipient being Professor Charles Schuchert, of Yale University.

The officers of the society for the year 1935 are:

President, Nevin M. Fenneman.

Past-president, W. H. Collins.

Vice-presidents, Edson S. Bastin, Donnel F. Hewett, John B. Reeside, Jr., Austin F. Rogers.

Secretary, Charles P. Berkey.

Treasurer, Edward B. Mathews.

Councilors, Frank F. Grout, W. O. Hotchkiss, Joseph Stanley-Brown, F. W. DeWolf, Donald H. McLaughlin, Adolph Knopf, Walter H. Bucher, Russell S. Knappen, E. L. Bruce.

The following geologists were elected foreign correspondents: Arthur L. Hall, assistant director of the Geological Survey of the Union of South Africa; Olaf Holtedahl, professor of paleontology, University of Oslo; Paul Niggli, professor of mineralogy and petrography, University of Zurich; Giuseppe Stefanini, professor of geology, Royal University of Pisa. Announcement was made of the election of twenty-two fellows. The total membership of the society is 685. Following is the list of newly elected fellows: Thomas Laval Bailey, Los Angeles; Milton Nunn

Bramlette, Washington, D. C.; William Horatio Brown, Gilman, Colorado; Theodore Chapin, Los Angeles, California; Louis Wade Currier, Washington, D. C.; Robert Henry Dott, Tulsa, Oklahoma; George Malcolm Fowler, Joplin, Missouri; George Herbert Girty, Washington, D. C.; Waldo Sumner Glock, Tucson, Arizona; Arthur Pharaoh Honess, State College, Pennsylvania; Henry Van Wagenen Howe, Baton Rouge, Louisiana; Richard E. Koeh, The Hague, Holland; James Bernard Macelwane, St. Louis, Missouri; Robert John Burgoyne Newcombe, Lansing, Michigan; Francis John Pettijohn, Chicago, Illinois; John Frank Schairer, Washington, D. C.; Laurence Lowe Smith, Columbia, South Carolina; Grace Anne Stewart, Columbus, Ohio; Francis Gerritt Wells, Washington, D. C.; Maynard Pressley White, Ardmore, Oklahoma; James Steele Williams, Washington, D. C.; Walter Byron Wilson, Tulsa, Oklahoma.

SCIENTIFIC NOTES AND NEWS

ON the occasion of the celebration of the one hundred and fiftieth anniversary of the Asiatic Society of Bengal twelve special anniversary honorary members were elected, including, in science: Albert Einstein, Sir Ernest Rutherford, Henry Fairfield Osborn, A. Lacroix and Sven Hedin.

DR. AMBROSE SWASEY, chairman of the board of the Warner and Swasey Company, will be the recipient of the Washington Award for 1935, which will be presented at a joint meeting of the Engineering Societies to be held in Chicago during the week of February 17. The award was founded by John W. Alvord in 1916, and is given "in recognition of accomplishments which preeminently promote the happiness, comfort and well-being of humanity and as the recognition of an engineer by his fellow engineers."

DR. JOSEPH S. AMES, president of the Johns Hopkins University, has received the award of the Langley Gold Medal of the Smithsonian Institution, in recognition of his work as chairman of the National Advisory Commission for Aeronautics, a position he has held since 1917.

THE honorary doctorate of the University of Brussels has been conferred by the faculty of sciences on Dr. Peter Debye, professor of experimental physics at Leipzig, and on Dr. Adolf Pascher, professor of botany in the German University at Prague.

IN celebration of the seventy-first birthday of Sven Hedin, the explorer, it is planned to publish in Sweden a volume in his honor, which will be written by other explorers. Crown Prince Gustaf Adolf of Sweden

is at the head of the group that has issued an invitation for public subscriptions.

ARTHUR S. TUTTLE, New York state engineer for the Federal Emergency Administration of Public Works and formerly chief engineer with the Board of Estimate and Apportionment of New York City, has been elected president of the American Society of Civil Engineers. Harrison P. Eddy is the retiring president.

THE following officers and councilors were elected at the annual meeting of the Society of American Bacteriologists held in Chicago, from December 27 to 29: *President*, Dr. Karl F. Meyer, director of the Hooper Foundation of the University of California; *Vice-president*, Dr. Thomas M. Rivers, member of the Rockefeller Institute for Medical Research; *Secretary-treasurer*, Dr. I. L. Baldwin, professor of agricultural bacteriology, the University of Wisconsin; *Councilors*, Dr. Lloyd D. Felton, assistant professor of preventive medicine and hygiene, the Harvard Medical School, and Dr. Stewart A. Koser, assistant professor of bacteriology, the University of Chicago. The next meeting will be held in New York, from December 26 to 28.

DR. FRANK D. DICKSON, of Kansas City, Missouri, was elected president of the American Academy of Orthopedic Surgeons at the meeting in New York on January 14. He succeeds Dr. Philip D. Wilson, of New York City. Dr. Melvin S. Henderson, of the Mayo Clinic, has been elected president of the American Board of Orthopedic Surgeons, a new board organized at the meeting.

At the annual program meeting of the Northwest Scientific Association in Spokane, Washington, on December 28 and 29, the following officers were elected: *President*, W. A. Rockie, Soil Experiment Station, Pullman, Washington; *Vice-president*, Thos. Bonser, curator, Spokane Museum, Washington; *Secretary-treasurer*, O. W. Freeman, State Normal School, Cheney, Wash. The meeting for 1935 will be held at the Davenport Hotel in Spokane, on December 27 and 28. A special symposium will be held on problems of soils and soil erosion.

WAYNE M. FAUNCE will fill the vacaney of vice-director of the American Museum of Natural History, created through the promotion of Dr. Roy Chapman Andrews to the directorship. Other promotions approved by the trustees include that of Dr. E. W. Gudger, from bibliographer and associate to associate curator of living and extinet fishes; Francesca R. La Monte, from assistant curator to associate curator; Marcelle Roigneau, from staff assistant in comparative anatomy to assistant curator of comparative and human anatomy; Hazel Gay, from acting curator of library and publications to librarian; John T. Zimmer, from associate curator of birds of the western hemisphere to acting curaor.

DR. ELLEN FITZ PENDLETON, formerly associate professor of mathematics at Wellesley College and since 1911 its president, has tendered her resignation to take effect in June, 1936.

DR. JAMES FRANCK, formerly professor of physics, University of Göttingen, now at the University of Copenhagen, has been appointed professor of physics at the Johns Hopkins University. Dr. Franck served in the German army in the war and seven years ago received the Nobel Prize for his work in physics.

DR. LEONARD CARMICHAEL, professor of psychology at Brown University, has been appointed lecturer in psychology at Harvard University for the second semester.

THE Committee on Scientific Research of the American Medical Association has made a grant in aid of research to Dr. S. S. Liehtman on the metabolism of bile salts in health and in disease of the liver and bile passages. The work will be carried on in the Mount Sinai Hospital, New York City.

DR. BUNJIRO TERADA, associate professor of pharmacology in the Manchurian Medical College, Mukden, Manchuria, has arrived in San Francisco under a fellowship of the Rockefeller Foundation for a period of study and research in the department of pharmacology, Stanford University School of Medicine.

THE Rockefeller Foundation has made a grant to Dr. Harry R. DeSilva, professor of psychology at

Massachusetts State College, to construct a cathode ray oscillograph and a thyratron electrical stimulator to be used in the study of action currents in the human body which do not enter the higher brain centers.

PROFESSOR R. A. EMERSON, of the New York State College of Agriculture at Cornell University, is spending a part of his sabbatic leave in Yucatan, Mexico, with J. H. Kempton, of the U. S. Department of Agriculture, under the auspices of the Carnegie Institution of Washington and the U. S. Department of Agriculture, in a preliminary study of the wild relatives of *Zea Mays*. It is hoped also that materials of interest in a study of the genetics of maize and its relatives may be found. After the trip to Yucatan, Professor Emerson will visit the laboratories of genetics and plant breeding in California and several of the southern and middle western states.

PROFESSOR C. A. EDWARDS, of Swansea, Wales, lecturer for the American Institute of Metals, will give two lectures at the Carnegie Institute of Technology, Pittsburgh, on February 28 and March 1. He will discuss the factors governing the growth of metallic crystals and the effects of crystal size upon the properties of metals at his first lecture. The second lecture will deal with the influence of cold-rolling and annealing upon the properties of mild steel sheets.

THE Harry Burr Ferris lecture in anatomy at Yale University was given this year by Dr. Robert Chambers, professor of biology at New York University, on the "Mechanics of Cell Division." The lecture was illustrated by micro-moving pictures of dividing cells manipulated by a micro-dissection technique.

DR. MEL T. COOK, of the Rio Piedras Experiment Station, Puerto Rico, lectured at the Johns Hopkins University on January 8 on "West Indian Hurricanes, their Origin and their Effects."

DR. EDWARD KASNER, professor of mathematics at Columbia University, will address the Galois Institute of Mathematics at Long Island University on January 26 on "Transcendental Numbers."

DR. P. J. HANZLIK, professor of pharmacology at the Stanford University School of Medicine, San Francisco, recently delivered a series of graduate lectures on pharmacology and therapeutics, under the auspices of the Seattle General Hospital and King County Medical Society in Seattle.

A LECTURE entitled "Experience on a Stratosphere Flight," illustrated by both moving and stationary pictures, was given at the Franklin Institute, Philadelphia, on January 10, by Mr. and Mrs. Jean Piccard.

DR. J. B. S. HALDANE, professor of genetics at the University of London and head of genetical research

at the Johns Innes Horticultural Institution, has been appointed to deliver the twelfth annual William Thompson Sedgwick memorial lecture at the Massachusetts Institute of Technology on Friday, January 25. He speaks on "Some Problems of Mathematical Biology" in the main lecture hall of the institute at 4:30 p. m. The lecture will be open to the public. The Sedgwick Memorial lectureship was established in 1922 in commemoration of the services of Professor William T. Sedgwick to the cause of biology and public health.

DR. LOTHAR NORDHEIM, formerly at Göttingen, now in Holland, will lecture during the summer session at Purdue University on "Modern Developments of Quantum Mechanics and Nuclear Physics."

THE twelfth International Congress of Sociology will be held under the auspices of the International Institute of Sociology of Geneva in connection with the Universal Exposition at Brussels, from August 25 to 30. The secretary of the congress is Professor G. L. Duprat, of the University of Geneva. Professor Charles A. Ellwood, of the department of sociology at Duke University, is the president of the International Institute for next year and will preside at the congress.

THE Midwestern Psychological Association will hold its tenth annual meeting as guest of the department of psychology at the University of Kansas on May 10 and 11.

By the will of Alba B. Johnson, formerly president of the Baldwin Locomotive Works, the Jefferson Medical College and Hospital will receive \$250,000. He was president of the college.

DIRECTORS of the Boxer Indemnity Fund have made a grant of \$10,000 to the Catholic University of Peiping, China, to aid the department of micro-biology in anti-typhus research.

COLUMBIA UNIVERSITY has announced gifts amounting to \$47,868. The Carnegie Corporation has given \$17,500 for dental research. Gifts of \$2,000 and over include: \$5,000 from the Brain Research Foundation for the department of neurology; an anonymous gift of \$2,500 to establish a fund to be known as the "fund for studies in Endocrine-Cytology in the Department of Anatomy"; an anonymous gift of \$3,000 to establish a fund to be known as the "Special Surgical Bacteriological Research Fund in the Department of Surgery." The Committee of Citizens of Holland gave \$2,000 for the Queen Wilhelmina Professorship.

THE University of California has received \$50,000 from the estate of Mrs. Jean Conrad. Among the other larger gifts were: Robert P. Scripps, Cincinnati,

\$4,200 for the Scripps Institution of Oceanography at La Jolla; Eli Lilly Company, Indianapolis, \$2,400 for the study of leprosy in the Medical School.

It is noted in the *Bulletin* of the Institute of International Education that the Institute of Parasitology of MacDonald College, Quebec, which was recently dedicated, is said to be the only institute in the world built especially for the study of animal parasites. The Quebec Government provided the building, and the National Research Council will maintain the institute. A portion of the building has been in operation for some time, and has been drawing its research material from stock maintained locally, from collectors stationed in every province, including the Northwest Territories situated within the Arctic Circle, from the Quebec Zoological Gardens, and from individual naturalists, stock owners and others throughout the Dominion and in the West Indies, as well as from other parts of the Empire.

DR. BERNHARD ZONDEK, formerly of Berlin, the well-known gynecologist, has become the head of the gynecological and obstetrical departments of the Rothschild-Hadassah Hospital in Jerusalem. He has assumed his work in the renovated, modernized and enlarged obstetrical pavilion of the hospital with laboratories at his disposal to continue his research. Dr. Zondek, who is co-discoverer of the Ascheim-Zondek test used in the diagnosis of pregnancy, was formerly the head of the department of gynecology of the Hôpital de Charité of the University of Berlin up to the time of the Hitler régime. When the Nazi government came into power, he and his two equally well-known brothers, Drs. Hermann and Samuel Zondek, went to Manchester, England. When the Rothschild-Hadassah-University medical center is built on Mt. Scopus, new laboratories will be equipped for the research of Dr. Zondek. He will not only be head of the gynecological and obstetrical departments of the new hospital, but will be professor of gynecology in the post-graduate medical school, which will be a part of the medical center. His research work in Palestine will be partly financed by a grant of \$2,000 from the Rockefeller Foundation. Nine other German exiled physicians were added to the staff of the hospital during the past year. Among these is Professor Ludwig Halberstädter, who brought the first supply of radium into Palestine. He is director of the new Institute of Radiology in Jerusalem. Thirty other German physicians are studying in the hospitals and clinics.

To make "deep fish" soundings in a lake 5,000 feet above sea level, and to collect birds, plants and small mammals for the Academy of Natural Sciences of Philadelphia, Mr. and Mrs. Rodolphe M. de Sehauensee, accompanied by Waldemar Fioravanti, of Flor-

ence, Italy, left on January 20 for two months of exploration in the central highlands of Guatemala. The expedition will be joined by Brando Barringer and Reginald Jacobs, of Philadelphia, who will make the round trip by airplane. Lake Atitlan is high set among the mountains, with a known depth of more than 1,000 feet. With a specially constructed wire

trap lowered by reel, Mr. de Schauensee, who is one of the curators in the department of vertebrate zoology of the academy, will seek to secure additions to the few species of fishes now recorded from this body of water, which may be much deeper than it now is believed. The expedition has permits to collect rare orchids which are found in that part of the country.

DISCUSSION

THE WHITNEY SOUTH SEA EXPEDITION

THE work of the American Museum's Whitney South Sea Expedition in collecting birds in the New Zealand region from December, 1925, to April, 1926, for unexplained reasons has aroused much unwarranted criticism. The charges brought against us are so often untrue or admittedly based on hearsay that they have seemed to us to be unworthy of attention, but they continue to be made and, in some instances, to involve other American museums. It seems desirable, therefore, that we should reply to those which are sufficiently definite to make a reply possible. It is remarkable that in no single instance have these charges been made direct to the American Museum. If they had been, we should have replied to them at once. We have nothing to conceal, and if excess of zeal should have led our collector to violate the ethics of his profession, we should be among the first to admit and to regret it. But invariably these accusations have reached us through a third or fourth person or in some publication. For this reason, as well as from the nature of some of the criticisms, we conclude that neither the affiliations nor the objects of the Whitney Expedition are known to those who have attacked it. They should, therefore, be stated before these attacks are replied to.

In 1920 the American Museum of Natural History of New York City, under a fund provided by the late Harry Payne Whitney, inaugurated an ornithological survey of the islands of the Pacific. This was designed to include a comprehensive view of the avifauna as a whole and an intensive study of the birds of all the more important islands, the whole being intended to help solve the problems connected with the origin and development of insular faunas. The field work was entrusted to Rollo H. Beck, a leader among American bird collectors, who from 1913 to 1917 had served the museum with marked success on the coasts of South America and in the West Indies.

Mr. Beck began his labors at Papeete in 1920 and, in command of the 75-foot Tahitian schooner *France*, continued as the leader of the expedition until 1928, making what is doubtless the longest ornithological voyage in history. During this period he secured in the aggregate a large number of specimens, but when

it is remembered that he visited not less than 600 islands and islets, and over 1,000 localities, it will be realized that the number secured at each station is not in excess of the needs of science. And we add, with all possible emphasis, that in no case has our work endangered the existence of a species or materially affected its numbers. It should also be remembered that while Old World museums are often well supplied with birds from the area visited, American museums were usually without them. Contained in our collections, they are now available to our sister museums.

Thus far 44 papers have been published on the work of the Whitney Expedition. They mark merely the beginning of researches which are now being conducted by an associate curator who has been placed on our staff especially to study the Whitney Expedition collections. Attention should also be called to the fact that the success of the expedition induced its patron to offer to the City of New York the sum of \$750,000 if it would appropriate an equal amount for the construction of an addition to the museum to be devoted exclusively to the museum's department of birds. This building, known as the Whitney Wing, is now completed and will be occupied during the coming year. One entire floor in it will be given to habitat groups illustrating the bird-life of the Pacific. At this moment an expedition on the yacht *Zaca*, under the command of its owner, Mr. Templeton Crocker, is making studies and securing accessories for these exhibits.

It is also pertinent to state that after Mr. Whitney's death his wife and children purchased and presented to the American Museum, in his memory, the unique Rothschild collection of birds. It may, therefore, be said that directly and indirectly the Whitney South Sea Expedition is one of the most notable undertakings in the annals of ornithology.

I turn now to the charges that have been made against this expedition. They are usually so unfounded or seem to us to be so trivial that if they did not, in some instances, reflect on other American museums we should not feel justified in asking space in which to reply to them.

Thus, for example, in a pamphlet issued by the

New Zealand Bird Protection Society in 1926 (p. 4), it is said "we understand at least two museums are interested in the present [Whitney] Expedition and that there are more to follow, so the matter better be threshed out at once as to whether the authorities are to be permitted to thus distribute the people's heritage to foreigners." Various references are also made to the "monetary value" of the specimens collected, to the institutions in America backing the expedition.

In a letter from England to Dr. Henry B. Ward, permanent secretary of the American Association for the Advancement of Science, Beck is referred to as a "dealer" in bird skins. The truth is that the American Museum is solely responsible for the Whitney Expedition and that, with the exception of certain specimens given to government authorities, and in one case to an artist, all the specimens collected by the expedition were sent to the American Museum.

The character of much of the criticism directed toward the expedition is reflected in the following communication:

"Have you heard Sydney Porter's story of the American Whitney expedition which has been going around all the islands in the South Seas where there are very rare birds and wiping them right out to provide specimens for the countless American museums? He says they have exterminated the Antipodes Island Parrakeet and flightless snipe, the Norfolk Island Parrakeet, the Masked Parrakeet (they killed 18 and none have been seen wild since), the Fijian *aureocinctus* lorikeet and the lovely blue lorikeets I hoped one day to be able to afford to send a collector to obtain a few live pairs of! I hope there may be some exaggeration, but I fear it is all too likely, as one knows what American collectors are. I think, anyhow, we should let American ornithologists know our unvarnished opinion of the whole business if anything of the kind has really happened. If they were afraid of the birds dying out before enough museum specimens had been secured, if they had caught a few pairs of the parrakeets *alive* they could have bred them in the wonderful California climate, got all the specimens they wanted, and saved the species as well." (April 2, 1934.)

Evidently we have here the source on which the Marquess of Tavistock based his attack on the Whitney Expedition published in *The Auk* for July, 1934. The same issue of that magazine contained my reply to him and as briefly as possible, therefore, I state here that of the Antipodes parrakeet (*Cyanoramphus unicolor*) we collected 2 specimens, of the snipe (*Coenocorypha aucklandica tristrami*), 2, of the Norfolk Island parrakeet (*Cyanoramphus verticalis*), 2; of the Fijian parrakeet (*Charmosynopsis aureo-cincta*), 12, of the masked parrakeet, 26, and of the

very common, widely distributed blue lorikeet (*Vini peruvianus*), a representative series from 8 islands.

It should be admitted that the number of masked parrakeets secured is in excess of our needs. However, Vitu Levu, the island it inhabits, is larger than southeastern England and the greater part of it is still unexplored. The fact that in a brief visit Beck could have secured so large a series of this forest-inhabiting species is evidence of its abundance, while the restriction of his labors to a limited part of its range indicates that he could not have seriously affected its numbers.

The suggestion that we breed parrakeets and thereby base our studies of geographical variation and insular evolution on aviary specimens merely demonstrates its maker's ignorance of the requirements of science.

I append now serially other charges together with our replies to them:

(1) "When the Expedition arrived in New Zealand waters, instead of making straight for Auckland or Wellington to ask for permission to collect birds, they delayed their arrival, staying in the Hauraki Gulf and collecting birds on the island sanctuaries, the homes of the rarest of the New Zealand birds, where one may not even land without permission from the Government. Previous to this they collected in the Chatham Islands, where all the birds are protected by the New Zealand Government."

This is untrue. The expedition arrived in New Zealand in December, 1925, and no collecting was done there until December 17, the date on which our permit was issued. Chatham Island was not visited until March 4, 1926, nearly three months later. No collecting was done in the Hauraki Gulf or its sanctuaries.

(2) It has been said that in many instances Beck collected more specimens than his permit allowed.

This is unfortunately true of his work on Chatham Island. There our permit granted permission to take four specimens each of *Hapolorhyncus albifrons*, *Petroica macrocephala* and *Rhipidura flabellifera*, and the expedition secured eight, nine and eight specimens, respectively, of these species. It should be recalled, however, that when several members of an expedition take to the field independently they can not be acquainted with one another's doings until they return to headquarters. While no individual, therefore, may exceed the prescribed number of a given species, their work as a whole may do so. As evidence that in the aggregate the expedition's activities on Chatham Island did not make excessive demands on its bird-life, it should be stated that while our permit allowed us 44 specimens of 9 land birds, we collected but 38. It should be added that specimens of the "excess" species were presented by Beck to the

New Zealand Dominion Museum from which we hold due acknowledgment.

(3) "The ship landed at the Antipodes and did great slaughter, especially among the Royal Albatrosses (*Diomedea epomophora*) which at that time were nesting. Many times the dinghy (the small boat from the ship) was so loaded with bodies that it almost sank" (letter to Dr. Ward).

This statement is exaggerated. Beck collected 17 specimens of the royal albatross, not at Antipodes but at the Chathams and in surrounding waters. Two of these have been given to the Cleveland Museum, two to the Museum of Comparative Zoölogy in Cambridge, two to the Bishop Museum in Honolulu and one to the Royal Zoological Museum in Stockholm, leaving ten in the American Museum, not an excessive number of an abundant species.

(4) "I also met someone in Norfolk Island who was residing there when the Expedition called, and he said that the Norfolk Island Parrakeet (*C. cooki* = *C. verticalis*) which was at that time common was almost wiped out and only during this last year or two have any been seen. This also happened to the Norfolk Island Robin" (letter to Dr. Ward).

The expedition secured two specimens of the parakeet, as stated above, and 15 of the robin, a common species.

(5) "Numbers of skins of the nearly extinct Sand Plover (*Thinornis novaeseelandiae*) were obtained and also the skins of other very rare birds" (letter to Dr. Ward).

Our permit allowed us to collect 10 specimens of this plover; Beck took but six.

(6) "The Expedition, however, raided the Kermades without asking any permission. . . ." "A permit was obtained and they sallied forth raiding our islands, with the result we found some rare birds were exterminated, such as the Antipodes Parrakeet" (letter of E. V. Sanderson, Hon. Secy N. Z. Native Bird Protection Society to International Wild Life Protection Society, Cambridge, Mass.).

It is true that Beck landed on the Kermades before he had received his collecting permit. He passed these islands on his voyage from Fiji to New Zealand, from which they are distant about 600 miles. To have visited New Zealand first and then returned to the Kermades would therefore have added 1,200 miles to his journey. He was now so far south of the latitudes in which his vessel was built to cruise that every day added to the length of his journey increased its risks. He can perhaps, therefore, be excused if he made his collections in advance of the permit that was subsequently granted him. Beck's "raid" on the Kermades consisted in collecting 27 specimens of land-birds, none of them representing rare species.

Of the Antipodes parrakeet, as already stated,

Beck collected 2 specimens. Since his visit to the island in 1926, Oliver ("New Zealand Birds," 1930) writes that this species is common there. Mr. Sanderson's charge that Beck exterminated this bird is evidently, therefore, unfounded.

This covers the more tangible charges of which we are aware. I am confident that if our critics had been more accurately informed of the results of our labors and more fully acquainted with our objectives, they would have been more discriminating in their accusations.

FRANK M. CHAPMAN,
Curator, Department of Birds, American
Museum of Natural History, New York City

NOVEMBER 20, 1934

THE WESTERN INVASION OF SAMIA CECROPIA

The Cecropia moth is one of the most familiar insects of the United States, native from Canada to Florida, and west to Nebraska. When Packard's memoir on the Saturniidae was published (1914), it was not known in Colorado, that region being occupied by another species, *Samia cecropia*, which could be found from the foothills to the high mountains, and was common. When "The Zoology of Colorado" was published (1927) *S. cecropia* had invaded the eastern plains of that state, and was reported to be destructive in orchards. Soon after, it began to appear in other parts of Colorado, and now it is abundant at Boulder, as indicated by the numerous specimens brought to the university each summer. Since *S. cecropia* came in, I have not seen a single *S. cecropia*. The last actual date I have for *S. cecropia* is Estes Park, 1917, collected by Mrs. R. S. Tallant. I presume that *S. cecropia* still exists in the mountains, but it seems to have disappeared where *S. cecropia* has appeared. The specimens of *S. cecropia* do not appear to be hybrids, or at any rate are distinctly *S. cecropia* and not *S. cecropia*. It is probable that *S. cecropia* is twice or three times as abundant as *S. cecropia* ever was, but even so, it leaves plenty of room and plenty of food for the latter species.

Mr. Walter R. Sewardner, of the University of Pittsburgh, has just published (*Entomological News*, November, 1934) a very interesting article which seems to throw important light on this problem. He found, in Montana, that *S. cecropia* would mate with *S. cecropia* in a state of nature, and he even observed a male *S. cecropia* mated with a female *S. cecropia*, while a female *S. cecropia* a few feet away remained unmated. Raising various *Samia* hybrids, he found that the females were sterile, but the males would mate with one of the parent species and produce healthy offspring. Now it would seem that if *S. cecropia* invades the territory of *S. cecropia*, and is two or three

times as abundant as that species, and there is no obstacle to crossing, then the great majority of *S. gloveri* will mate with the wrong species, and the females so produced will be sterile. The males will usually mate with *S. cecropia*. Thus *S. gloveri* will disappear, but the critical examination of numerous specimens should show traces of *S. gloveri* ancestry. I offer this note at the present time because it is important that all entomologists living in the Rocky Mountain region should be aware of what is going on, and should collect specimens and make observations throwing light on a case which may well become classic in the annals of biology.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

THE RING STRUCTURE OF THYMIDINE

THE detailed structure of the nucleic acid molecule can not be formulated without knowledge of the ring structure of the constituent nucleosides, which, for

nucleosides of the desoxyribose type, has not yet been established. In the case of ribose nucleosides, the furanose ring structure has been shown by two methods, one based on methylation of the nucleosides, the other on the formation of a mono-trityl derivative. It was found that in the pure mono-trityl derivative, the trityl group is located on the primary alcoholic group of the sugar.

The latter method has now been applied to the study of the ring structure of thymine-2-desoxyriboside. A pure mono-trityl derivative was obtained and thus the conclusion is warranted that the desoxyribose nucleosides likewise have the furanose structure.

The properties of mono-trityl thymidine are as follows: m.p. 125°; $[\alpha]_D^{24} = +11.4^\circ$ (in acetone).

P. A. LEVENE
R. STUART TIPSON

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
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SOCIETIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE thirty-fifth meeting of the Tennessee Academy of Science was held in Nashville, Tennessee, at Vanderbilt University, on Friday and Saturday, November 30 and December 1, 1934. In cooperation with the academy, its affiliated societies, the Tennessee Ornithological Society and the Tennessee Barnard Astronomical Society, held their annual meetings and contributed papers to the program.

Classification of the papers shows: Anatomy 2, astronomy 2, bacteriology 1, biochemistry 3, biology 9, chemistry 2, forestry 2, geology 2, meteorology 1, ornithology 1, pathology 1, psychology 2, physics 2, physiology 2. The average attendance at the meetings was about fifty, but more than one hundred were present to hear the paper by William R. Amberson, of Memphis, on "Haemoglobin-Ringer, a New Substitute for Blood in Mammals," which was illustrated with motion pictures.

Dr. A. Richard Bliss, director of the Reelfoot Lake Biological Station, made a report on investigations at the station last summer. Secretary McGill made a report which showed a decrease of 10.6 per cent. in the membership of the academy since 1931 and an increase of more than 100 per cent. in the number of members that are fellows of the American Association for the Advancement of Science.

On Friday evening, Dr. Otto Struve, director of the Yerkes Observatory of the University of Chicago, Mrs. Struve and the president of the Barnard societies of Chattanooga and Knoxville were the guests at the academy dinner at 6 p. m. in the Andrew Jackson

Hotel. At 8 p. m. Dr. Struve delivered the academy address in the auditorium of the War Memorial Building on the subject, "Modern Conceptions of the Universe."

The officers of the academy elected for the year 1935 are:

George M. Hall, professor of geology, University of Tennessee, Knoxville, *President*; Dr. William Litterer, Tennessee state bacteriologist, Nashville, *Vice-President*; John T. McGill, professor of organic chemistry, emeritus, Vanderbilt University, Nashville, *Secretary-Treasurer*; Jesse M. Shaver, professor of biology, George Peabody College, Nashville, *Editor of the Journal*; Miss Eleanor Eggleston, assistant librarian, Vanderbilt University, Nashville, *Librarian*.

JOHN T. MCGILL,
Secretary

THE SECOND QUADRENNIAL CONGRESS OF THE MATHEMATICIANS OF THE SLAV COUNTRIES

LAST summer there took place in Europe four quadrennial regional mathematical congresses—in Lenigrad (end of June), Stockholm (mid-August), Athens (early September) and the congress of the Slav countries in Prague (September 23–28). The undersigned had the opportunity of attending the first and fourth, the last as delegate of the National Academy of Sciences. The strongest impression received was regarding the seriousness of the consequences of increasing governmental interference in all domains, science not excluded. Thus, for various political reasons, a num-

ber of the closest neighbors of Czechoslovakia had hardly any representatives at Prague. The organizing committee, and particularly its prime mover, Dr. M. Valouch, did their best to counteract this tendency and in so doing they had as good success as could be expected. There were a number of foreign delegates, and the congress had a strong international tinge. There were very pleasant social activities and numerous opportunities to get together scientifically and otherwise. The congress had eight sections devoted to the principal branches of mathematics with 111 individual communications. There were also a number of more extended lectures by E. Cech ("On

Duality Theorems in Topology"), V. Jarnik ("On Geometrical Number Theory"), Sierpinski (Superpositions of Functions, this address being read by Professor Cech owing to the absence of the lecturer), Menger ("Metrical Geometry") and others.

The organizers of the congress can not be praised too highly for their endeavors. It is only through such meetings that one may hope to nullify to some extent the ever-growing scientific autarchy the world over, the most serious menace to science at the present time.

S. LEFSCHETZ

PRINCETON, N. J.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE CULTIVATION OF ENDAMOEBA HISTOLYTICA IN ERLENMEYER FLASKS

WHEN large numbers of *Endamoeba histolytica* are needed in culture, either for the inoculation of a series of experimental animals or for the preparation of antigen for the complement fixation test, the use of test-tube cultures is both expensive and time-consuming. A single rich culture in a test-tube is sufficient for the inoculation of only one kitten, and in testing the degree of pathogenicity of a strain of *E. histolytica* it is advisable to use at least twenty kittens. In the preparation of antigen several hundred tubes of rich cultures are required. We have found that much labor and some expense can be saved by growing the amoebae in Erlenmeyer flasks.

Probably any of the accepted media for cultivating *E. histolytica* may be employed in this way. We have used the medium recommended by Dobell and Laidlaw¹ consisting of whole egg diluted with Ringer's solution, overlaid with horse serum diluted with six parts of Ringer's solution and enriched with sterile rice flour.² We have used 250 cc flasks for cultivating amoebae for our animal inoculations and have found that one flask provides approximately the same number of amoebae as twenty-five to thirty test-tubes of 25 cc capacity. In the preparation of antigen we have used 500 cc flasks and have found that twenty-five to thirty flasks provide as much antigen as 350 to 400 test-tubes.

In the test-tube containing slants of coagulated egg-Ringer medium the amoebae multiply only in the rice flour and bacterial sediment at the bottom of the slant, whereas in a flask they have the whole egg-Ringer surface at the bottom to multiply upon. Approximately 15 cc of egg-Ringer mixture are required

in a 250 cc flask, and 25 cc in a 500 cc flask. This covers the bottom of the flask in a thin layer. The egg-Ringer is coagulated by placing the flasks in a pan of boiling water, in an Arnold sterilizer or in the autoclave heated by live steam without pressure. The flasks must be watched to avoid overheating, which causes the formation of bubbles. A smooth base is desirable in order to provide the best surface for growth. After coagulation the flasks are autoclaved and placed in the refrigerator until needed. The serum-Ringer and rice flour are added a few days before use, and are tested for sterility by incubating for at least forty-eight hours before inoculation. Approximately 75 to 85 cc of horse-serum-Ringer are required for a 250 cc flask and 125 to 150 cc for a 500 cc flask. This provides a depth of fluid over the egg-Ringer base of about seven eighths of an inch. Approximately 0.25 cc of sterile rice flour is added to each flask. For inoculation with *E. histolytica* approximately 1 cc of a rich culture is transferred to each flask. This will usually give excellent growth in 48 to 72 hours. As with test-tube cultures a flask occasionally fails to produce good growth for some unexplained reason, but the chance of failure is less with flasks than with test-tubes.

The advantages of the flask method of cultivation are a saving in time in preparation of media and washing of glassware, a saving in glassware and a saving in media. A 250 cc flask requires only one fifth as much egg-Ringer and only three fifths as much horse serum-Ringer as twenty-five test-tubes. Furthermore, the chance of contamination in handling fewer containers is greatly reduced, owing to the reduction in the number of transplants. Again the chances for cultural variations in individual tubes is eliminated when constant conditions are desired in the inoculation of a series of animals. There is also a considerable reduction in the amount of rice flour used, which is a distinct advantage in the preparation

¹ C. Dobell and P. P. Laidlaw, *Parasitology* 18: 283-318, 1926.

² L. R. Cleveland and J. Collier, *Amer. Jour. Hyg.* 12: 606-613, 1930.

of antigen, as it is desirable to wash the amoebae as free as possible from the solid constituents of the culture before extracting.

Test-tube cultures are, of course, more practical than flask cultures for simply maintaining strains of amoebae, since only a few tubes are required. They are also useful for seeding flasks when these are required.

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ON THE REMOVAL OF OXYGEN FROM WATER BY CUT BRANCHES¹

IT is well known that rooted plants, in water, will remove the dissolved oxygen rapidly, under certain conditions, or not at all, under other conditions. Among the modifying environmental characters are the temperature of the water and the insolation of the shoot. Whether or not rootless shoots, or branches, with leaves, may behave in an analogous way does not appear to be known. The present note indicates that they have the capacity of removing

oxygen at least, but whether the rate of such removal can be modified by the factors above mentioned remains to be shown.

In the experiments here summarized the cut ends of leafy branches of a few species of shrubs and trees were kept in distilled water for various lengths of time and the oxygen content of the water was determined at the beginning and at the end of the experimental periods. It was found, in every instance, that the oxygen content of the water was decreased. A similar result was obtained with cut flowers.

As to the effect of the external factors spoken of above, a few experiments appeared to indicate that the temperature of the water had little influence, as opposed to the results with plants having roots. It is possible, however, that the rate of oxygen removal is related to the intensity of the light to which the shoot is exposed. In four experiments, for example, with leafy branches of mulberry the rate of removal was greater during darkness than light.

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SPECIAL ARTICLES

MEASUREMENT OF THE VELOCITY OF LIGHT IN A PARTIAL VACUUM¹

THE plan to measure the velocity of light in a vacuum was proposed in 1929 by the late A. A. Michelson, professor of physics at the University of Chicago and research associate of the Carnegie Institution of Washington. He obtained the funds for the project and lived to see the apparatus installed, but was unable to take part in the measurements, which were carried out by F. G. Pease, of the Mount Wilson Observatory of the Carnegie Institution of Washington, and F. Pearson, of the University of Chicago. The apparatus was installed at Irvine Ranch, near Santa Ana, California; observations were made at intervals during the period from February, 1931, to March, 1933. The method used was that of the rotating mirror, the mirror itself being a cylinder of glass, on the periphery of which 32 equally inclined and optically flat surfaces were ground and figured parallel to the axis. The cylinder was rotated about its axis at a speed such that a beam of light reflected by one surface and traveling a distance of 8 or 10 miles was received and reflected by the next succeeding face of the compound mirror. From the measured speed of rotation of the mirror and the length of path of the beam of light, the velocity of light was readily deduced. The mirror was driven by an airblast regulated by a sensitive, hand-controlled valve; its rotational speed was ascertained stroboscopically by bringing it into coinci-

dence with the vibrations of an electrically driven tuning fork whose frequency was in turn determined stroboscopically by comparison with the period of a gravity pendulum swinging freely under reduced air pressure. The rate of the pendulum was ascertained by flash-box methods in terms of an accurate clock whose rate was determined by comparison with corrected radio time signals from Arlington. For the two optical path lengths of 8 and 10 miles the speeds of the mirror were 730 and 585 rotations per second, respectively. The apparatus was mounted in a tube one mile in length, consisting of 60-foot sections of corrugated steel pipe 36 inches in diameter joined with rubber sleeves, placed on trestles a foot above ground and evacuated to pressures ranging from $\frac{1}{2}$ to 5 mm of mercury. Steel tanks were attached to the ends of the tube; in these the optical parts, consisting of a small diagonal flat, an image-forming concave mirror and two 22-inch optical flats, were installed. Light from an arc lamp, after passing through a collimating lens and slit, was reflected from the upper half of the rotating mirror through an optically plane window in the side of the tube, and after repeated reflections was imaged on one of the large flat mirrors. It was then returned over a path just below the entering path, received on the lower half of the rotating mirror and thence through a small diagonal prism into a micrometer eyepiece. The length of the path followed by the beam of light was ascertained by reference to a base established with extreme care by the U. S. Coast and Geodetic Survey by the side of the pipe line. The ends of the base consisted of two concrete piers with inserted bronze reference plates placed opposite to the 22-inch plane mirrors. Transfer of the positions of these mirrors to the

¹ The study was made with the aid of a grant from the Carnegie Institution of Washington.

¹ Read before the National Academy of Sciences, Cleveland, 1934.

reference plates of the base line was effected by means of an accurate steel straight edge placed in line with and parallel to the mirror faces. The remaining necessary distances between mirrors were measured by steel tapes. Allowance was made for window thickness and air distance from the window to the rotating mirror. The mean paths were 12,811.204 and 15,999.744 meters for the 8- and 10-mile paths, respectively. Fifty-six measures of the base line were made.

The results of the several series of observations are listed in Table I.

TABLE I

Series	Date	Number of determinations	Velocity of light	Average deviation
1-54	1931—Feb. 19 to July 14	493	299,770	12
1-56	1932—Mar. 3 to May 13	753.5	780	11
57-104	1932—May 13 to Aug. 4	742	771	9
105-179	1932—Dec. 3 to 1933, Feb. 27	897	775	11
		2,885.5	299,774	11

The simple mean of the 2,885.5 separate determinations gives for the velocity of light in *vacuo* 299,774 km/sec. The average deviation (A.D.) given in the table is that of a single series from the mean of the group. A plot of the weighted velocity readings with respect to time shows the following characteristics. The mean velocity for 1931 is 299,770 km/sec. The mean value for the series 14-25 is 299,746 km/sec. while the value for the remainder of the year lies close to 299,775 km/sec. The mean values for the first 56 series of measures for 1932 is 299,780 km/sec. and that for series 57-104, ending in August, 1932, and including approximately the same number of observations, is 299,771 km/sec. If the readings be taken in small groups and the means plotted, the curve through these points starts early in March at 299,784 km/sec., runs slightly above the axis until early in May and then drops to 299,768 km/sec. early in June. Several fluctuations appear in the curve at this time. The curve remains below the axis until observations stopped on August 4. The mean value for 1932-33 is 299,775 km/sec. The curve starts early in December at 299,785 km/sec., crosses the axis about January 1 and reaches a value of 299,765 km/sec. about January 15. It then gradually rises to 299,787 km/sec. late in February. When the velocities were first plotted, each evening's observations were taken as a unit. A curve freely drawn through these points resembled somewhat the tide curve of the water depths at the nearby coast at a lunital interval of 10 hours later. To check this apparent relationship sun-moon tide curves were drawn by the U. S. Coast and Geodetic Survey on their tide-predicting machine and careful comparisons were made of the various components of the tide curves with the

velocities. The best correlation seemed to be one between velocity and the horizontal component of the tide force perpendicular to the tube, the velocities being high for a strong tide force pulling in a southeasterly direction and low for a northwesterly direction. The dispersion of readings, however, is great, and consequently little weight can be attached to this relation. The same may be said regarding a plot of velocities and moon diameters. Independent plots of both the early 1932 and the 1932-33 observations each show the same feature, namely, that the velocity is high when the diameter is either large or small, suggesting tidal effects. The scattering, however, is large and the results questionable. The formation of the weighted mean curve has, however, eliminated most of the apparent periodic fluctuations. Repeated measures of the base line and checks on the clock rate showed no changes capable of producing the residual differences between the mean curve and the axis. A vibration of the mirror system with a period equal to a fraction of that of the rotating mirror conceivably may have produced the rapid fluctuations observed in the individual readings.

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EXPERIMENTAL STIMULATION DEAFNESS

IT has frequently been reported, and also denied, that prolonged exposure of animals to loud tones causes histological damage to the organ of Corti or loss of sensitivity to sounds as judged by conditioned reflexes. Recently the electrical responses of ear and auditory nerve have also been employed in this type of experiment as additional indicators of possible damage.¹ During the past two years, we have exposed five groups of animals (cats and guinea-pigs) to tones of 600, 800 or 2,500 c.p.s. and examined them by one or more of these methods. We believe that our results throw some light on the variability apparent in previous reports.

In testing auditory function of anesthetized animals by the electrical response, we pick up an electrical potential at the round window and observe the amplified electrical waves with a cathode ray oscilloscope. The intensity of sound necessary to cause a just-visible deflection is taken as threshold. The sensitivity of normal cats and guinea-pigs determined by this method corresponds quite closely to the normal human audibility curve and is in excellent agreement with our own and with Horton's² determinations of the sensitivity of guinea-pigs by the method of conditioned reflexes. This justifies the use of the electrical method in testing auditory function.

¹ E. G. Wever, C. W. Bray and G. P. Horton, "The Problem of Stimulation Deafness as Studied by Auditory Nerve Technique," SCIENCE, 80: 18-19, 1934.

² G. P. Horton, "A Quantitative Study of Hearing in the Guinea Pig (*Cavia Cobaya*)," Jour. Comp. Psychol., 15: 59-73, 1933.

A preliminary group of 3 cats and 3 guinea-pigs was exposed to 600 c.p.s. at 85 db above human threshold for durations up to 2 months. They were tested electrically, and the guinea-pig ears were examined histologically. None of them showed significant deviations from normal or recognizable histological lesions.

A second group of 5 guinea-pigs was exposed to 800 c.p.s. at 95 db for 16 hours a day for durations up to 74 days. All these animals were equally normal by electrical test.

A third group of 13 normal guinea-pigs was exposed to 600 c.p.s., 9 at 65 db and 4 at 95 db for 70 and 75 days, respectively. They were tested by the conditioned-reflex method (Kemp³) at frequencies 400, 500, 600, 700 and 800 c.p.s. before and after exposure. One of the first 9 and all the second 4 animals showed slight losses of sensitivity amounting to not more than 20 db at most in this range. The other 8 remained normal. The animal most affected showed by the electrical method an average deficiency of 12 db over the entire range from 15 to 1,500 c.p.s., but was practically normal from 1,750 to 10,000 c.p.s. There was no specific loss at or near 600 c.p.s. Histological examination of this ear revealed degenerate external hair-cells in the organ of Corti scattered through the second, third and fourth turns. In no region were more than 25 per cent. of the cells abnormal.

Seven guinea-pigs, 3 exposed to a d₄ whistle (about 2,400 c.p.s.) at 97 db for 15 hours a day for 40 days and 4 to 2,500 c.p.s. at 106 db for 45 days, all showed loss of sensitivity electrically and degeneration of external hair-cells histologically. Three of the most severe cases showed maximal losses of 76 db, 52 db and 50 db, and also distortions of wave form in the response. The zone of greatest loss lay in each case between 1,200 and 1,800 c.p.s. Two of these animals on histological examination each showed in both ears extensive degeneration of external hair-cells and also a rupture of Reissner's membrane in the second and third turns. The animal with greatest loss showed similar degeneration of cells and also hemorrhage into the scala media. The remaining 4 guinea-pigs showed losses of sensitivity, varying in degree from 20 to 56 db, in the range from 750 c.p.s. to 1,500 c.p.s. In the mildest case the loss involved only this range, while in the most severe the entire range tested (60 to 10,000 c.p.s.) was involved. The loss in the latter case averaged 37 db from 70 to 250 c.p.s., 52 db from 375 to 1,500 c.p.s., 40 db from 1,750 to 5,000 c.p.s., and 20 db from 6,000 to 12,000 c.p.s. The other 2 were intermediate in degree, but essentially similar in type. Histologically all showed more or less severe

³ E. H. Kemp. In press.

degeneration of external hair-cells in a wider or narrower zone of the organ of Corti, centering in each case in the middle third of the second turn of the cochlea. The severity and extent of the lesion correlated closely with the degree and extent of abnormality of the audiogram. The transition from normal to abnormal was gradual, both in the audiogram and in the histological picture.

These results indicate that the frequency as well as the intensity of the exposure tone may be an important factor in determining whether or not the inner ear is damaged. Considerable individual differences in susceptibility are also indicated. Intense exposure may apparently cause extensive loss of hearing, although we have not yet encountered the type of extreme loss affecting the entire range equally, as described by Finch and Culler.⁴ The gross internal damage to the inner ear in some of our cases shows that interpretation is impossible without proper histological examination. In experiments now in progress we hope to extend the correlation of losses shown by the electrical method with loss of response by the method of conditioned reflexes. It is somewhat surprising and difficult of explanation that the zone of greatest loss of sensitivity as determined electrically does not necessarily coincide in frequency with the exposure tone. The losses and also the pathological lesions are wide-spread, indicating that the resonance of the basilar membrane is not sharp, but the more favorable cases of moderate damage support the "place" theory of pitch perception and relate the frequency 1,200 c.p.s. with the middle of the second cochlear turn in the guinea-pig. This is approximately the middle of the audible range and also approximately the middle of the basilar membrane.

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⁴ G. Finch and E. Culler, "Effects of Protracted Exposure to a Loud Tone," SCIENCE, 30: 41-42, 1934.

BOOKS RECEIVED

ALLEN, ARTHUR A. *American Bird Biographies*. Pp. ix + 238. 20 plates. 189 figures. Comstock. \$3.50.
Anales del Museo Argentino de Ciencias Naturales, "Bernardino Rivadavia." Tomo XXXVII. Pp. xiv + 581. Illustrated. Museo Nacional de Historia Natural, Buenos Aires.
 KRAUSE, ARLINGTON C. *The Biochemistry of the Eye*. Pp. xv + 264. 17 figures. Johns Hopkins Press. \$3.25.
 LUTZ, FRANK E. *Field Book of Insects*. Pp. 510. 800 illustrations. Putnam's. \$3.50.
 PENDRAY, G. EDWARD. *Men, Mirrors and Stars*. Pp. x + 339. 31 plates. 47 figures. Funk and Wagnalls. \$3.00.